



DOE's DELIVERY RELIABILITY RESEARCH TARGETS NATIONAL GOALS FOR MORE EFFICIENT AND RELIABLE PIPELINE NETWORK

CONTACT POINTS

Rodney Anderson

Product Manager

Delivery Reliability

304-285-4709

rodney.anderson@netl.doe.gov

Julianne Klara

Senior Analyst

412-386-6089

412-386-6195 fax

julianne.klara@netl.doe.gov

CUSTOMER SERVICE

800-553-7681

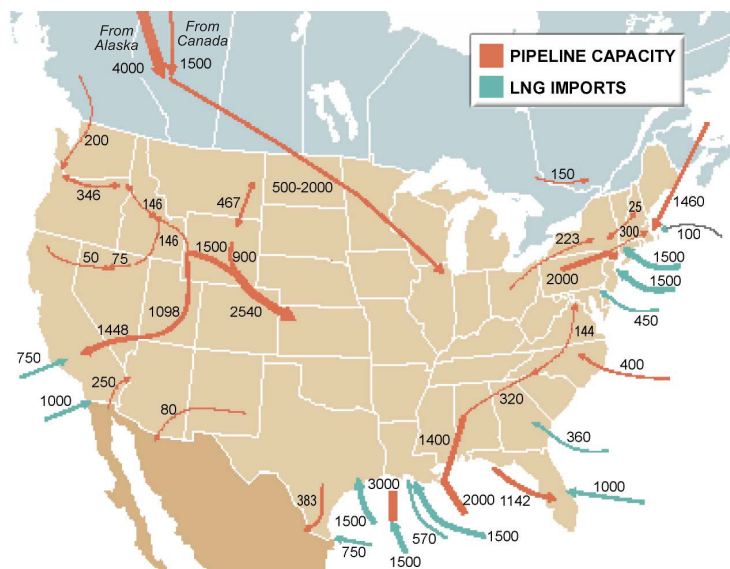
NETL WEBSITE

www.netl.doe.gov/

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng/

The U.S. interstate natural gas mainline transportation network, at the end of 2002, operated about 212,000 miles of pipeline and had the capability to deliver more than 133 billion cubic feet (Bcf) of gas per day. This includes more than 3500 miles of pipeline that were added to the national pipeline network during 2002 at an estimated cost of \$4.4 billion.¹ It is anticipated that the United States will have to invest \$8 billion per year in new and expanded pipeline and distribution infrastructure through 2025 to handle new productive capacity and to meet increased demand for natural gas.² At the same time the pipeline industry also faces the immense challenge of ensuring the integrity and reliability of its aging infrastructure. As the nation depends more and more on natural gas to meet its year-round energy needs, it is essential that the infrastructure that connects demand with supply be expanded and improved.

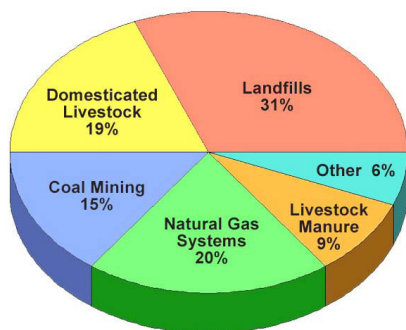


New Pipeline and LNG Capacity² (million cubic feet per day) Change from 2003 to 2025

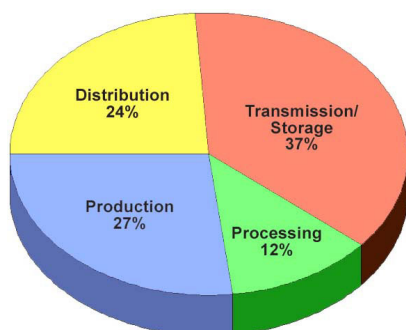
The goal of the Natural Gas Delivery Reliability Program is to maintain and enhance the integrity, operational reliability, and efficiency of the nation's natural gas infrastructure. Based on a collaborative approach to identify priorities and opportunities for research and development (R&D) funding, projects supported by DOE are developing technologies to ensure the availability of clean, affordable energy for our homes, businesses, and industries. Project descriptions can be found at www.netl.doe.gov/scng



Natural Gas T&D is a Large Source of Methane Emissions – A Potent Greenhouse Gas



In 1992, natural gas systems accounted for 20% of major methane sources to total U.S. anthropogenic emissions.³ This quantity of gas (314 billion scf) is significant, equating to 6% of natural gas consumed by the U.S. electric power sector in 2000.⁴



In 1992, T&D and storage were responsible for releasing 117 billion scf into the atmosphere, or 61% of all methane emissions from the natural gas industry.³

Delivery Reliability Research at NETL Targets Three Key Initiatives for Energy and the Environment

1. **Clear Skies Initiative:** Clear Skies is a comprehensive policy to reduce emissions of SO₂, NO_x, and mercury from the power generation sector.
2. **Climate Change Initiative:** The goal of this voluntary program is to cut U.S. greenhouse gas (GHG) emissions and reduce GHG intensity 18% by 2012.
3. **Energy Security:** This program seeks to diversify energy resources and develop new technologies for distributed generation. The program also promotes conservation, using domestic resources, and modernization of energy delivery systems.

Delivery Reliability: Clear Skies

One means of meeting the Clear Skies Initiative goal of reduced power plant emissions will be continued and expanded use of clean natural gas to generate electricity. To meet a projected >50% growth in natural gas consumption, primarily driven by the increased use of gas to fuel our power plants, major investments in capacity additions will be required. In addition to a \$35 billion investment in new transmission lines and storage capacity, nearly twice that investment (about \$70 billion) will be required for new distribution facilities in the United States.²

Adding pipeline miles is not the only way to meet the challenge of delivering more natural gas. NETL believes that the capacity of the existing infrastructure can be increased by as much as 10% through improved system utilization and maintenance and by enhancing flexibility and responsiveness of the network to react to changes in long term demand. Optimizing system operations to increase the capacity of existing facilities will save billions of dollars in avoided infrastructure investments.

If technologies developed under DOE's Delivery Reliability Program avoided only 5% of the estimated \$105 billion² cost for new and enhanced T&D infrastructure, the savings would be significant – \$5.3 billion.



Delivery Reliability: Climate Change

The natural gas transmission and distribution (T&D) system is a large source of methane emissions — a potent greenhouse gas, which by weight has 23 times higher global warming potential than CO₂. In 1992, nearly 20% of major anthropogenic methane emissions came from the natural gas industry, equaling 1.4% of U.S. natural gas production that year. Assuming that methane emissions account for 1% of gas production in 2010, annual methane releases from T&D and storage of natural gas could reach 4 million tons.³

A specific objective of DOE's Natural Gas Delivery Reliability Program is to protect the environment by fostering new technology that reduces or eliminates fugitive emissions. NETL's R&D goal is a 50% reduction in T&D methane emissions by 2010. Achieving this goal would reduce methane emissions by 2 million tons each year (46 million tons per year CO₂ equivalent).

Delivery Reliability: Energy Security

One key to ensuring energy security is to decentralize the Nation's power generating system. Generating electricity at or close to the point of power consumption relieves demand on the congested electric transmission and distribution network. However, this strategy increases demand for natural gas to fuel these distributed power generators resulting in the need for additional pipeline capacity. Further, more than 88% of existing transmission pipe is more than 40 years old, and an increasing share of infrastructure investment will be required to sustain the reliability of existing infrastructure.²

DOE initiated its Delivery Reliability Program in 2000 to help coordinate national efforts to ensure system reliability and deliverability during this period of rapid natural gas demand growth and transition. In addition to optimizing the system to increase capacities of existing facilities, the Program is also developing advanced concepts that sense damage or other threats to pipeline integrity and provide responses that could range from notification of operators to self-repair.

Why Do We Need Natural Gas Delivery Reliability Research?

The vast underground T&D system and the natural gas powered compressors that provide the force to move the gas have proven to be incredibly safe, reliable, and efficient. The present system is working well. Several emerging issues, however, indicate a clear need for federal attention to guarantee the continued health of the natural gas T&D network. Natural gas demand is expected to grow by 54% in the coming decades⁴ and the traditional seasonal consumption patterns are changing due to the increased use of gas for electricity generation. To further complicate the future, there have been recent changes in the natural gas market including deregulation, a rapid pace in mergers and acquisitions, and increased emphasis on environmental concerns. These changes put pressure on prices at the consumer level and have forced T&D companies to focus on short-term cost cutting at the expense of research and development, which will test the system's potential to serve expanding future markets.

The goal of the Natural Gas Delivery Reliability Program is to sponsor R&D to ensure the integrity, operational reliability, efficiency of the nation's natural gas infrastructure both now and in the future.

Benefits of DOE's Delivery Reliability Program:

- Reduced greenhouse gas (methane) emissions by 2 million tons per year by 2010, which is equal to sequestering the CO₂ emissions from 14 aging 500 MW coal-fired power plants.
- Increased pipeline network efficiency that, by 2010, eliminates 2.2 million tons of annual natural gas losses valued at more than \$150 million.
- Increased integrity and reliability.
- New capabilities to meet predicted growth in demand, avoiding \$5.3 billion in additional T&D infrastructure costs

The Federal Role: Ensuring the Health of the Natural Gas T&D Network

Increased demand for natural gas (for power generation), deregulation, mergers and acquisitions, and environmental concerns have put pressure on prices at the consumer level.

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DOE responded to this new challenge by working with infrastructure experts to establish these R&D priorities:

- **Inspection Technologies:** Innovative sensors, perhaps on robotic platforms, that provide enhanced assessments of the status of T&D facilities, including detection of corrosion defects, cracking, physical damage, gas contamination, and intrusion near gas line right-of-ways
- **Remote Sensing:** Advanced technologies that more quickly cover extended regions to detect intrusion, detect and image metallic and non-metallic underground facilities, and cost-effectively detect and quantify natural gas leaks
- **Operational Technologies:** New technologies and methods to improve efficiency, reliability, and integrity of T&D operations including prevention of corrosion and pipe deterioration, optimization of the system to increase existing capacity, and development of next generation compressors
- **Materials Development:** Smart pipe and in-situ repair technologies for both metal and plastic pipe, which will utilize mobile and/or robotic platforms, to sense damage or other threats and respond with notification or self-repair

Delivery Reliability Program Drivers

- The availability of clean energy as a prerequisite to United States economic strength.
- Natural gas accounting for one-fourth of the nation's energy consumption.
- Domestic natural gas offsetting increases in dependence on petroleum imports.
- Market conditions causing a reduction in industry R&D.
- The United States maintaining global leadership in natural gas technology.
- Natural gas as a partial solution to greenhouse gas emission reductions.

1 EIA. May 2003. Expansion and Change on the U.S. Natural Gas Pipeline Network – 2002.

2 National Petroleum Council. 2003. Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy. Volume I.

3 Harrison, et al. 1997. Project Summary: Methane Emissions from the Natural Gas Industry.

4 EIA, 2002. Annual Energy Outlook: 2003.